



# Applications of business analytics in healthcare

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**Abstract** The American healthcare system is at a crossroads, and analytics, as an organizational skill, figures to play a pivotal role in its future. As more healthcare systems capture information electronically and begin to collect more novel forms of data, such as human DNA, how will we leverage these resources and use them to improve human health at a manageable cost? In this article, we argue that analytics will play a fundamental role in the transformation of the American healthcare system. However, there are numerous challenges to the application and use of analytics: the lack of data standards, barriers to the collection of high-quality data, and a shortage of qualified personnel to conduct such analyses. There are also multiple managerial issues, such as how to get end users of electronic data to employ it consistently to improve healthcare delivery and how to manage the public reporting and sharing of data. In this article, we explore applications of analytics in healthcare, barriers and facilitators to its widespread adoption, and ways in which analytics can help us achieve the goals of the modern healthcare system: high-quality, responsive, affordable, and efficient care.

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## 1. Healthcare: An industry in need of analytics

The American healthcare system has long suffered from constrained resources, increasing demand, and questionable value, yet the future looks more

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promising due to increasingly sophisticated and widespread uses of data and analytics. Past performance of the healthcare system provides insight regarding why change was, and still is, necessary. The Centers for Medicare and Medicaid (CMS) estimate that healthcare represents a staggering 17.9% of U.S. gross domestic product (GDP) and that the United States spent \$2.7 trillion, or \$8,680 per person, on healthcare in 2011 (CMS, 2013a). According to the Organization for Economic Co-operation and Development (OECD), which ranks the performance of international healthcare systems, the United States ranked 27<sup>th</sup> in life expectancy at birth in 2009 despite having the highest proportion of GDP spent on healthcare (OECD, 2011).

This raises questions regarding the value of the U.S. healthcare system. There are multiple reasons for this value deficit. First, the third-party-payer system decouples the payer from the individual receiving services, mitigating some checks and balances on costs. Second, there is a lack of aligned incentives in the existing fee-for-service system, which promotes consumption of resources and overuse rather than overall patient health and well-being. Third, there are unique barriers to competition that prevent innovation, which are not present in other industries. Fourth, for-profit insurers, fraud, and waste divert a portion of healthcare funds away from paying for care. Finally, despite information technology's (IT) role in rapidly advancing the productivity of many other industries (e.g., Rawley & Simcoe, 2012), IT adoption in healthcare has sorely lagged behind.

The Affordable Care Act (ACA) and the Health Information Technology for Economic and Clinical Health (HITECH) Act—a component of the American Recovery and Reinvestment Act (ARRA) of 2009—have initiated tremendous change in healthcare. Fueled by the carrot-and-stick approach of the HITECH Act, hospital adoption of at least basic electronic health records (EHRs) has nearly doubled from 2008 to 2012, with 44% of U.S. hospitals using at least a basic EHR (DesRoches et al., 2013). Without an EHR, much healthcare data are contained in paper format. Widespread EHR adoption sets the stage for electronic data collection and subsequent analysis. The next phase entails transforming these data into actionable information packets that can be used to improve healthcare delivery.

Now that the necessary data pieces are being put into place, analytics can and must play a pivotal role in the transformation of American healthcare into an efficient, value-driven system. With investments in healthcare IT implementation and a shift in focus from quantity of treatment to overall healthcare value, the stage is set for the application of

advanced analytics. As the ACA is implemented, incentives should be more in line with patient health and well-being while achieving value for limited healthcare resources.

Although healthcare has taken longer than other industries to incorporate the use of analytics, such adoption is radically transforming healthcare delivery for the better. In this article, we discuss how healthcare is fundamentally changing in response to the application of analytics. We also discuss how data are collected, organized, and analyzed as well as the challenges facing the widespread adoption of analytics in healthcare. In addition, we discuss managerial issues and ways in which analytics can produce a meaningful output for organizations and individuals alike. Finally, we conclude with specific examples illustrating the application of analytics to healthcare delivery. We use examples from the visualization of data in quality improvement, genetics, comparative effectiveness, chronic disease databases, disaster planning, and asset tracking to demonstrate how the application of analytics to healthcare is improving the way healthcare is delivered and to demonstrate the unique analytical issues this application raises.

## 2. The analytics process in healthcare

### 2.1. Data generation

There is a tendency for hospitals and healthcare systems to operate and manage a wide range of clinical and operational information systems. While the interoperability requirements of 'meaningful use' (MU) (Blumenthal & Tavenner, 2010) are causing institutions to consolidate their clinical information systems into enterprise-wide EHRs (Marsolo & Spooner, 2013), most institutions still rely on a host of platforms. While not an exhaustive list, examples of such platforms are described next and are summarized in Table 1:

- *EHRs*—EHRs have become one of the largest sources of digital information on the health and well-being of patients. Spurred in part by the ARRA and MU, the rate of EHR adoption has grown dramatically (DesRoches et al., 2013; HealthIT.gov, 2013). EHRs are used to capture family, social, surgical, and medical history; allergies and immunizations; laboratory results; clinical findings; clinical orders; and other condition-specific information. Depending on the configuration of the EHR, this information may either exist in discrete fields or be captured as part of free-text notes (Marsolo & Spooner, 2013).

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